# APPENDIX 3B – AIR QUALITY MONITORING DATA

**Summary of Annual Average Dust Deposition**

| EPL 12425 ID No. | 3 | 4 | - | 6 | - | 9 | 10 | 11 | 12 | 26 |
|---|---|---|---|---|---|---|---|---|---|---|
| Monitoring ID No. | DG4 | DG5 | DG7* | DG8 | DG10 | DG11 | DG12 | DG13 | DG14 | DG15 |
| 2011 Annual Average Total Insoluble Matter (g/m²/month) | 0.40 | 1.13 | 1.22 | 0.94 | 3.02 | 1.30 | 3.73 | 1.95 | 1.88 | |
| 2012 Annual Average Total Insoluble Matter (g/m²/month) | 2.80 | 0.73 | 1.52 | 1.03 | 1.19 | 1.41 | 6.52 | 2.38 | 2.18 | |
| 2013 Annual Average Total Insoluble Matter (g/m²/month) | 1.20 | 0.60 | | 1.43 | 2.04 | 1.98 | 3.26 | 1.94 | 1.04 | 1.00 |
| 2014 Annual Average Total Insoluble Matter (g/m²/month) | 1.68 | 0.83 | | 1.48 | 3.31 | 1.28 | 3.28 | 2.81 | 1.43 | 0.85 |
| 2015 Annual Average Total Insoluble Matter (g/m²/month) | 0.90 | 0.80 | | 1.09 | 3.61 | 1.94 | 2.91 | 5.91 | 1.16 | 0.75 |
| 2016 Annual Average Total Insoluble Matter (g/m²/month) | 1.30 | 1.34 | | 1.10 | 1.88 | 4.18 | 2.48 | 33.81 | 4.80 | 1.64 |
| 2017 Annual Average Total Insoluble Matter (g/m²/month) | 1.3 | 1.4 | | 1.9 | 4.3 | 1.8 | 3.7 | 10.5 | 26.3 | 1.2 |
| 2018 Annual Average Total Insoluble Matter (g/m²/month) | 3.2 | 2 | | 1.7 | 3.7 | 2.2 | 5.2 | 4.1 | 6.6 | 1.3 |
| 2019 Annual Average Total Insoluble Matter (g/m²/month) | 5.3 | 2.7 | | 2.3 | 4.6 | 3.1 | 5.9 | 3.3 | 5.5 | 1.6 |

**Notes:** Grey shaded cells indicated compliance dust depositional monitoring sites. Green shaded cells indicated internal dust depositional monitoring sites at heritage sites. *At the end of the 2012 reporting period DG7 was relocated from the Mittaville Property to Araluen Road. Araluen Road is situated to the north east of Wollar Village. The new dust gauge is identified as DG15.

**Summary of TSP and $PM_{10}$ Results**

| | Monitoring Locations# | | | | | | |
|---|---|---|---|---|---|---|---|
| EPL 12425 ID No. | 13 | - | 20 | 27 | - | 25 | 28 |
| Monitoring ID No. | HV1 | HV3^ | HV4 | HV5 | TEOM1^ | TEOM3 | TEOM4 |
| **2012 Results** | | | | | | | |
| $PM_{10}$ (µg/m³) recorded range* | 2.8 – 21.7 | - | 12.0 – 21.8 | ** | 3.4 - 60.3 | ** | ** |
| $PM_{10}$ (µg/m³) annual average | 9.1 | - | 9.7 | ** | 9.7 | ** | ** |
| TSP (µg/m³) recorded range* | - | 1.9 – 47.0 | - | - | - | - | - |
| TSP (µg/m³) annual average | - | 18.8 | - | - | - | - | - |
| **2013 Results** | | | | | | | |
| PM10 (µg/m³) recorded range* | 1.2 – 43.7 | - | 2 – 55.1 | 1.8 – 49.8 | 3.0 – 82.5 | 2.4 – 55.6 | 0.7 – 68.9 |
| PM10 (µg/m³) annual average | 10.84 | - | 12.4 | 15.71 | 18.5 | 13.1 | 16.8 |
| TSP (µg/m³) recorded range* | - | 3.1 – 77.6 | - | - | - | - | - |
| TSP (µg/m³) annual average | - | 27.45 | - | - | - | - | - |
| **2014 Results** | | | | | | | |
| PM10 (µg/m³) recorded range* | 1.70 - 41.20 | - | 1.80 – 37.70 | 2.80 – 47.80 | 1.8-69.5 | 2.65 – 59.12 | 1.18 – 53.96 |
| PM10 (µg/m³) annual average | 11.15 | - | 11.95 | 14.58 | 17.3 | 13.2 | 13.5 |
| TSP (µg/m³) recorded range* | - | 7.20 – 59.0 | - | - | - | - | - |
| TSP (µg/m³) annual average | - | 23.09 | - | - | - | - | - |

**Summary of TSP and PM$_{10}$ Results (Continued)**

| Monitoring Locations# | | | | | | | |
|---|---|---|---|---|---|---|---|
| **EPL 12425 ID No.** | **13** | **-** | **20** | **27** | **-** | **25** | **28** |
| **Monitoring ID No.** | **HV1** | **HV3^** | **HV4** | **HV5** | **TEOM1^** | **TEOM3** | **TEOM4** |
| **2015 Results** | | | | | | | |
| **PM10 (µg/m$^3$) recorded range*** | 1.1 – 29.3 | - | 1.9 – 40.0 | 1.0 – 35.3 | 2.2 – 87.8 | 1.4 – 78.5 | 0.1 – 77.3 |
| **PM10 (µg/m$^3$) annual average** | 9.99 | - | 11.52 | 11.68 | 14.1 | 11.26 | 14.16 |
| **TSP (µg/m$^3$) recorded range*** | - | 3.7 – 68.7 | - | - | - | - | - |
| **TSP (µg/m$^3$) annual average** | - | 22.74 | - | | - | - | - |
| **2016 Results** | | | | | | | |
| **PM10 (µg/m$^3$) recorded range*** | 1.5 – 23.0 | - | 1.8 – 25.2 | 2.5 – 34.2 | 3.3 – 41.7 | 0.4 – 34.4 | 0.0 – 51.1 |
| **PM10 (µg/m$^3$) annual average** | 9.78 | - | 11.69 | 13.95 | 15.0 | 10.2 | 11.3 |
| **TSP (µg/m$^3$) recorded range*** | - | 3.9 – 82.0 | - | - | - | - | - |
| **TSP (µg/m$^3$) annual average** | - | 27.59 | - | - | - | - | - |
| **2017 Results** | | | | | | | |
| **PM10 (µg/m$^3$) recorded range*** | 2.1 - 28.2 | - | 4.5 - 69.1 | 5.1 - 55.4 | 2.9 - 86.7 | 0.9 - 52.2 | 0.9 - 50.9 |
| **PM10 (µg/m$^3$) annual average** | 12.2 | - | 16.7 | 16.6 | 18.4 | 9.5 | 12.8 |
| **TSP (µg/m$^3$) recorded range*** | - | 10.1 - 142.0 | - | - | - | - | - |
| **TSP (µg/m$^3$) annual average** | - | 38.1 | - | - | - | - | - |
| **2018 Results** | | | | | | | |
| **PM10 (µg/m$^3$) recorded range*** | 2.1 – 168 | - | 2.6 – 208 | 2.1 – 167 | 2.5 – 206.6 | 0.1 – 143.3 | 0.1 – 156.8 |
| **PM10 (µg/m$^3$) annual average** | 23.3 | - | 24.76 | 16.9 | 22.1 | 14.4 | 18.0 |
| **TSP (µg/m$^3$) recorded range*** | - | 5.6 – 237 | - | - | - | - | - |
| **TSP (µg/m$^3$) annual average** | - | 45.7 | - | - | - | - | - |
| **2019 Results** | | | | | | | |
| **PM10 (µg/m$^3$) recorded range*** | 2.8 - 196 | - | 3.6 - 207 | 3.0 - 195 | 0.6 – 107.8 | 3.0 – 242.8 | 3.8 – 273.1 |
| **PM10 (µg/m$^3$) annual average**** | 16.1 | - | 17.8 | 23.8 | ^^ | 14.6 | 22.9 |
| **TSP (µg/m$^3$) recorded range*** | - | 11.7 - 309 | - | - | - | - | - |
| **TSP (µg/m$^3$) annual average** | - | ^^ | - | - | - | - | - |

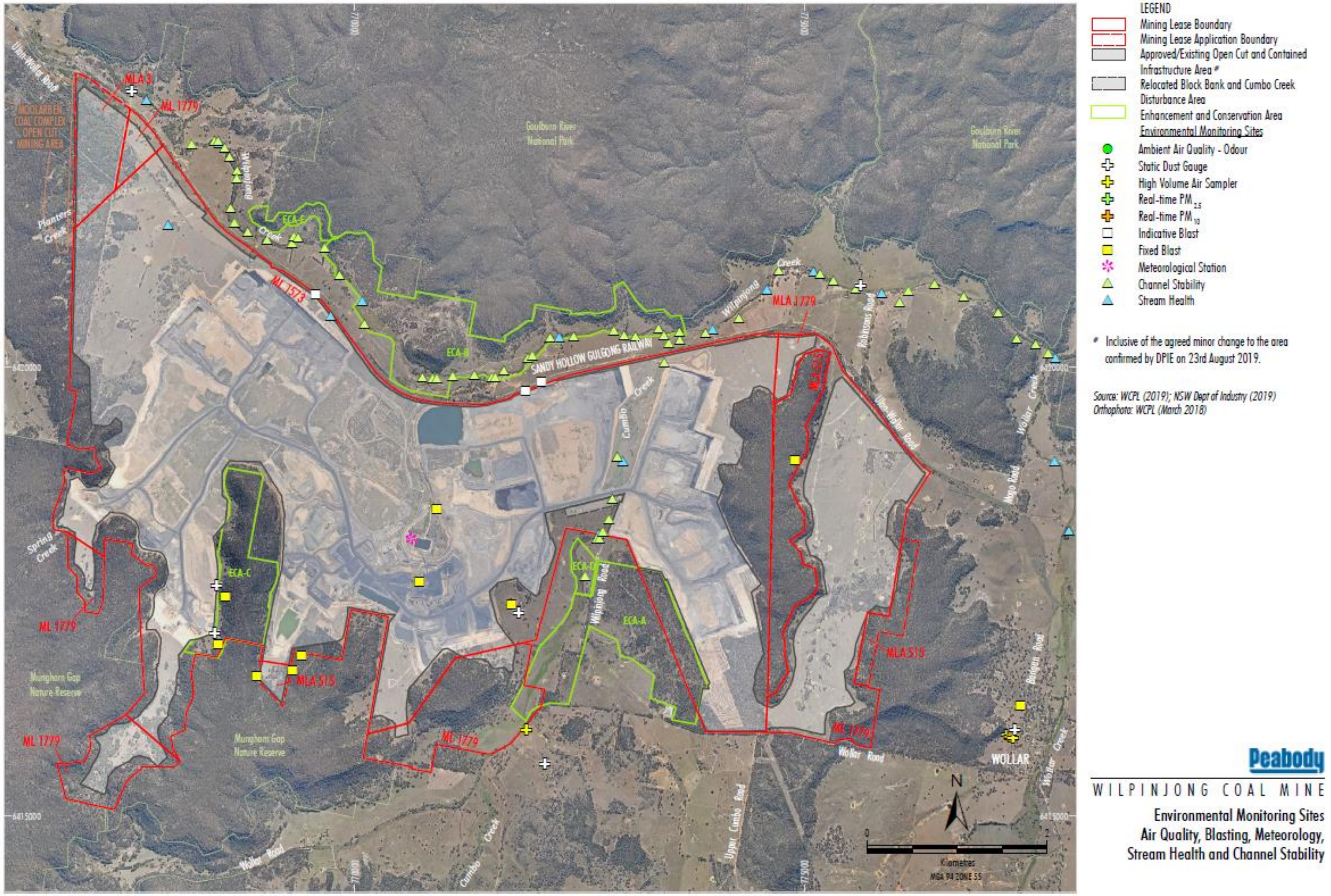
**Notes:** * Data presented is the range of minimum and maximum 24-hour averages and includes all extraordinary events in 2019. ^ Data recorded at these sites is not for compliance, but for management purposes only (in August 2020 both HV3 and TEOM 1 were decommissioned due to mining operations commencing in Pit 8). ^^Insufficient data for annual average calculation, data unavailable after 22 August 2019. # Refer to **Figure below.** **Annual averages exclude extraordinary events in 2019.

**Summary $PM_{2.5}$ Results**

| Monitoring Locations# | |
|---|---|
| **EPL 12425 ID No.** | **29** |
| **Monitoring ID No.** | **TEOM 5** |
| **2019 Results** | |
| **PM2.5 (µg/m³) recorded range*** | 1.1 – 196.5 |
| **PM2.5 (µg/m³) annual average **** | 6.8 |

**Notes:** * Data presented is the range of minimum and maximum 24-hour averages and includes all extraordinary events in 2019. ** Annual averages exclude extraordinary events in 2019.

## Air Quality Monitoring Stations




WIL-12-11_EMS 2019_205A

**Air Quality Monitoring Stations (Wollar)**

# Air Quality Monitoring Data Review
# Wilpinjong 2019

# AIR QUALITY MONITORING DATA REVIEW WILPINJONG 2019

Wilpinjong Coal Pty Ltd

31 March 2020

Job Number 18120907A

Prepared by
Todoroski Air Sciences Pty Ltd
Suite 2B, 14 Glen Street
Eastwood, NSW 2122
Phone: (02) 9874 2123
Fax: (02) 9874 2125
Email: info@airsciences.com.au

# Air Quality Monitoring Data Review
# Wilpinjong 2019

**DOCUMENT CONTROL**

| Report Version | Date | Prepared by | Reviewed by |
|---|---|---|---|
| DRAFT - 001 | 25/03/2020 | K Trahair | D Kjellberg |
| DRAFT - 002 | 30/03/2020 | K Trahair | |
| FINAL - 001 | 31/03/2020 | K Trahair | |
| | | | |
| | | | |
| | | | |

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# 1 INTRODUCTION

Todoroski Air Sciences have prepared this report for Wilpinjong Coal Pty Ltd (hereafter referred to as the Proponent). The report presents a review and analysis of the dust monitoring data recorded as part of the Wilpinjong Coal Mine (WCM) air quality monitoring network for the 2019 calendar period and includes a comparison between the measured dust levels and the modelled predictions for the Year 2020 per the *Air Quality and Greenhouse Gas Assessment Wilpinjong Extension Project* (**Todoroski Air Sciences, 2015**).

The modelled Year 2020 is considered representative of mining activity occurring during the 2019 calendar period at the WCM.

## 2 PROJECT SETTING AND DESCRIPTION

The WCM is located in the Western Coalfields of New South Wales (NSW), approximately 40 kilometres (km) northeast of Mudgee and approximately 2.5km west-northwest of Wollar (see **Figure 2-1**). National Parks and reserves, agricultural activities and coal mining operations dominate the land use in the surrounding area.

The WCM is bounded by the Goulburn River National Park to the north, the Munghorn Gap Nature Reserve to the southwest and Moolarben Coal Operations (MCO) to the west. To the east and southeast of the mine, the land is predominantly zoned for agricultural use, along with areas of Crown Land.

The WCM ambient air quality monitors include High Volume Air Samplers (HVAS), Tapered Element Oscillating Microbalances (TEOMs) and deposited dust gauges. The location of the air quality monitors relative to WCM is presented in **Figure 2-1**.

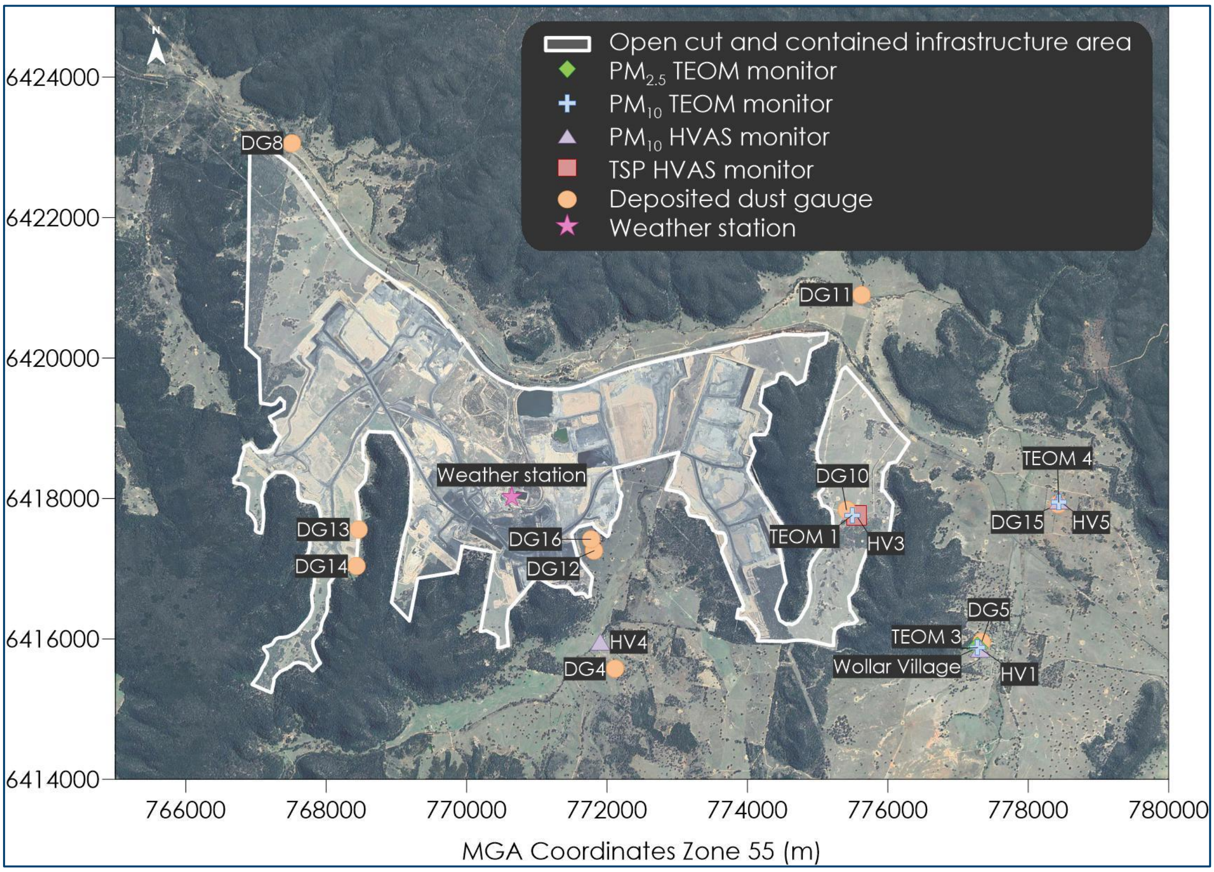


**Figure 2-1: WCM setting and air quality monitoring network**

**Notes:**

- Data from DG4, DG5, DG8, DG11, HV1, HV4, HV5, TEOM3 and TEOM4 are used for ***compliance monitoring*** against the Air Quality Assessment Criteria in accordance with Condition 17, Schedule 3 of SSD-6764;
- Data from DG12, DG13, DG14, DG16 are used for dust monitoring of Aboriginal heritage sites;
- Data from TEOM1, Wollar Village (TEOM5 $PM_{2.5}$), DG10, and HV3 are used for management purposes; and
- Data from DG15 are used for monitoring the nearest non-mine owned residence to the east of WCM.

# 3 AIR QUALITY CRITERIA

The sections below identify the key pollutants currently being monitored at the WCM air quality monitoring sites (refer to **Figure 2-1**) and the applicable air quality criteria.

## 3.1 Particulate Matter

Particulate matter consists of particles of varying size and composition. The total mass of all particles suspended in air is defined as the Total Suspended Particulate matter (TSP). The upper size range for TSP is nominally taken to be 30 micrometres (µm) as in practice particles larger than 30 to 50µm will settle out of the atmosphere too quickly to be regarded as air pollutants.

The TSP is defined further into two sub-components. They are $PM_{10}$ particles, particulate matter with aerodynamic diameters of 10µm or less, and $PM_{2.5}$, particulate matter with aerodynamic diameters of 2.5µm or less.

Particulate matter, typically in the upper size range, that settles from the atmosphere and deposits on surfaces is characterised as deposited dust. The deposition of dust on surfaces may be considered a nuisance and can adversely affect the amenity of an area by soiling property in the vicinity.

### 3.1.1 Development Consent

**Table 3-1** summarise the air quality goals that are relevant to particulate pollutants as outlined in the WCM Development Consent (SSD-6764).

The development consent outlines that the applicant shall ensure that all reasonable and feasible avoidance and mitigation measures are employed so that the particulate emissions generated by the operation do not exceed the criteria listed in **Table 3-1** at any residence on privately-owned land.

**Table 3-1: Air quality criteria - SSD-6764**

| Pollutant | Averaging period | [d] Criterion | |
|---|---|---|---|
| Particulate Matter < 10µm ($PM_{10}$) | Annual | [a] 30 µg/m³ | |
| | 24 hour | [a] 50 µg/m³ | |
| Total suspended particulates (TSP) | Annual | [a] 90 µg/m³ | |
| [c] Deposited Dust | Annual | [b] 2 g/m²/month | [a] 4 g/m²/month |

Notes:

[a] Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to other sources).

[b] Incremental impact (i.e. incremental increase in concentrations due to the development on its own).

[c] Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003 Methods for Sampling and Analysis of Ambient Air – Determination of Particulate Matter – Deposited Matter – Gravimetric Method.

[d] Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents, illegal activities or any other activity agreed to by the Secretary.

### 3.1.2 NEMP air quality standards

**Table** 3-2 summarises the air quality standards per the National Environment Protection (Ambient Air) Measure (NEPM) (**NEPC, 2016**). The NEPM standards were adopted by WCM for the assessment of $PM_{2.5}$.

**Table 3-2: NEPM air quality standards**

| Pollutant | Averaging Period | Maximum concentration standard |
|---|---|---|
| Particles as $PM_{10}$ | Annual | 25 µg/m³ |
| | 24-hour | 50 µg/m³ |
| Particles as $PM_{2.5}$ | Annual | 8 µg/m³ |
| | 24-hour | 25 µg/m³ |

### 3.1.3 NSW EPA impact assessment criteria

**Table 3-3** summarises the current air quality goals that are relevant to particulate pollutants as outlined in the NSW Environment Protection Agency (EPA) document "*Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*" (**NSW EPA, 2017**).

It should be noted the current NSW EPA air quality impact assessment criteria were updated after the Project was approved, and thus differ from the development consent criteria by adopting the NEPM standards for $PM_{2.5}$ and reducing the annual average $PM_{10}$ criteria from a level of 30µg/m³ to 25µg/m³.

**Table 3-3: NSW EPA air quality impact assessment criteria**

| Pollutant | Averaging Period | Impact [1] | Criterion |
|---|---|---|---|
| Total suspended particulates (TSP) | Annual | Total | 90 µg/m³ |
| Particulate Matter < 10µm ($PM_{10}$) | Annual | Total | 25 µg/m³ |
| | 24-hour | Total | 50 µg/m³ |
| Particulate Matter < 2.5µm ($PM_{2.5}$) | Annual | Total | 8 µg/m³ |
| | 24-hour | Total | 25 µg/m³ |
| Deposited Dust [2] | Annual | Incremental | 2 g/m²/month |
| | | Total | 4 g/m²/month |

[1] At nearest existing or likely future off-site sensitive receptor

[2] Dust is assessed as insoluble solids as defined by AS 3580.10.1 – 1991 (AM-19)

Source: **NSW EPA, 2017**

# 4 METEOROLOGICAL DATA

**Table 4-1** presents the total cumulative annual rainfall recorded by WCM for the latest five-year period. The 265.6 millimetres (mm) of rainfall recorded in 2019 was significantly lower than the previous years. The area around WCM is considered to have experienced intense drought conditions in 2019 (**NSW Department of Primary Industries, 2020**).

**Table 4-1: Total annual rainfall (mm)**

| Year | Total rainfall (mm) |
|---|---|
| 2015 | 772.2 |
| 2016 | 817.0 |
| 2017 | 531.4 |
| 2018 | 487.8 |
| 2019 | 265.6 |

Annual and seasonal wind roses have been prepared from the available data collected at the WCM weather station for the 2019 period and are presented in **Figure 4-1**.

Analysis of the wind roses show that on an annual basis the predominant wind flows at the WCM weather station are along a general east to west axis, which is expected considering the wider terrain features of the area. Very few winds originate from the northern and southern sectors.

The summer and autumn winds are predominately from the east-northeast and east. During winter, winds are primarily from the west, west-northwest and northwest. The spring wind distribution is similar to the annual distribution with winds from the east and east-northeast, followed by winds ranging from the southwest to the northwest.

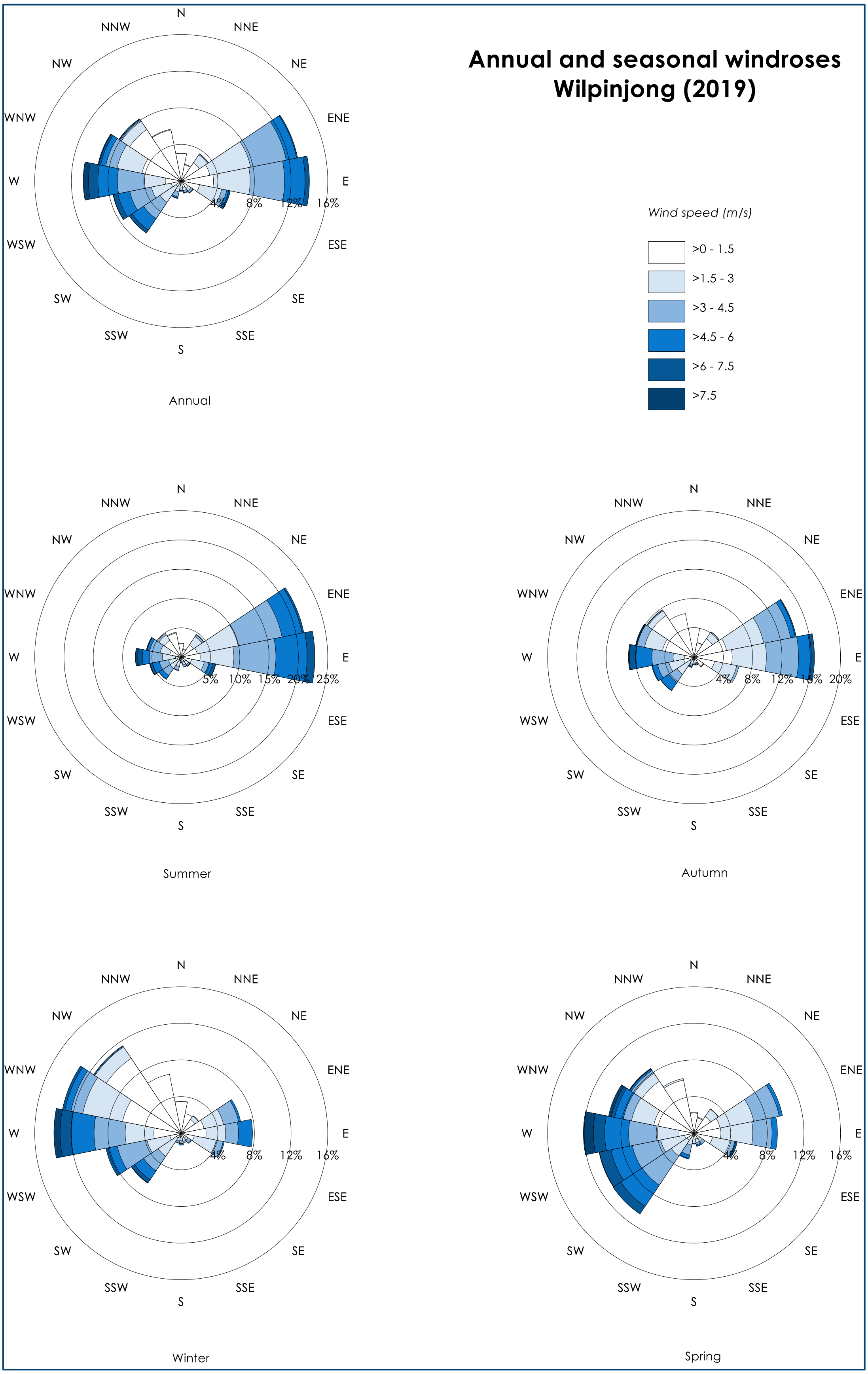


**Figure 4-1: Annual and seasonal windroses for Wilpinjong (2019)**

# 5 AIR QUALITY MONITORING DATA

This section reviews the available ambient monitoring data collected from the WCM ambient air quality monitoring network for the 2019 calendar period and compares it with the long-term data.

The main sources of particulate matter in the wider area of the WCM include active mining from coal mine operations, agricultural activities, emissions from local anthropogenic activities (such as motor vehicle exhaust, dust from dirt roads, and domestic wood heaters) and various other rural activities.

It is noted that in 2019 there were 61 days considered to be "extraordinary events" for WCM. The predominant cause of these extraordinary events was smoke associated with the 2019/2020 bushfires. A list of the days considered to be extraordinary events is provided as **Appendix A**. In addition, drought conditions in 2019 would have contributed to the dust levels in the vicinity of WCM with higher background levels and an increased frequency of dust storms.

This assessment considers both the annual averages calculated for all days and excluding these extraordinary event days.

## 5.1 $PM_{2.5}$ Monitoring

There are no specific $PM_{2.5}$ air quality impact assessment criteria in WCM Development Consent SSD-6764. WCM adopted the National Environmental Protection Measures (NEPM) standard for $PM_{2.5}$ in the WCM Air Quality Management Plan (AQMP). The data from monitoring $PM_{2.5}$ in the village of Wollar (previously known as TEOM 5) was established to determine if there is any correlation between the measured levels and WCM activities under applicable prevailing meteorological conditions.

A summary of the available $PM_{2.5}$ monitoring data is presented in **Table 5-1**. Recorded 24-hour average $PM_{2.5}$ concentrations are presented graphically in **Figure 5-1**. It is noted that the data from 28/06/2019 to 31/08/2019 was deemed invalid due a monitor flow leak.

The 2019 annual average $PM_{2.5}$ concentration for "all days" was above the relevant criterion of 8µg/m³ but was below the criterion when extraordinary events were excluded. The 24-hour average $PM_{2.5}$ concentrations were above the relevant criterion of 25µg/m³ for a significant number of days in 2019. The majority of these days were considered to be extraordinary events due (e.g. bushfires, dust storms, etc).

It can be seen in **Figure 5-1** that the $PM_{2.5}$ levels at the end of 2019 are significantly elevated compared with the rest of the data. The levels were affected by bushfire smoke across NSW during the 2019/2020 bushfire season.

**Table 5-1: Summary of ambient $PM_{2.5}$ levels - Wollar Village**

| Year | Annual average (µg/m³) | | Maximum 24-hour average (µg/m³) | | No. days > NEPM standard (25µg/m³) | |
|---|---|---|---|---|---|---|
| 2018 | 6.6 | | **35.6** | | 5 | |
| 2019 | **15.2** | *6.8 | **196.5** | *23.0 | 32 | *0 |

* Excluding extraordinary events

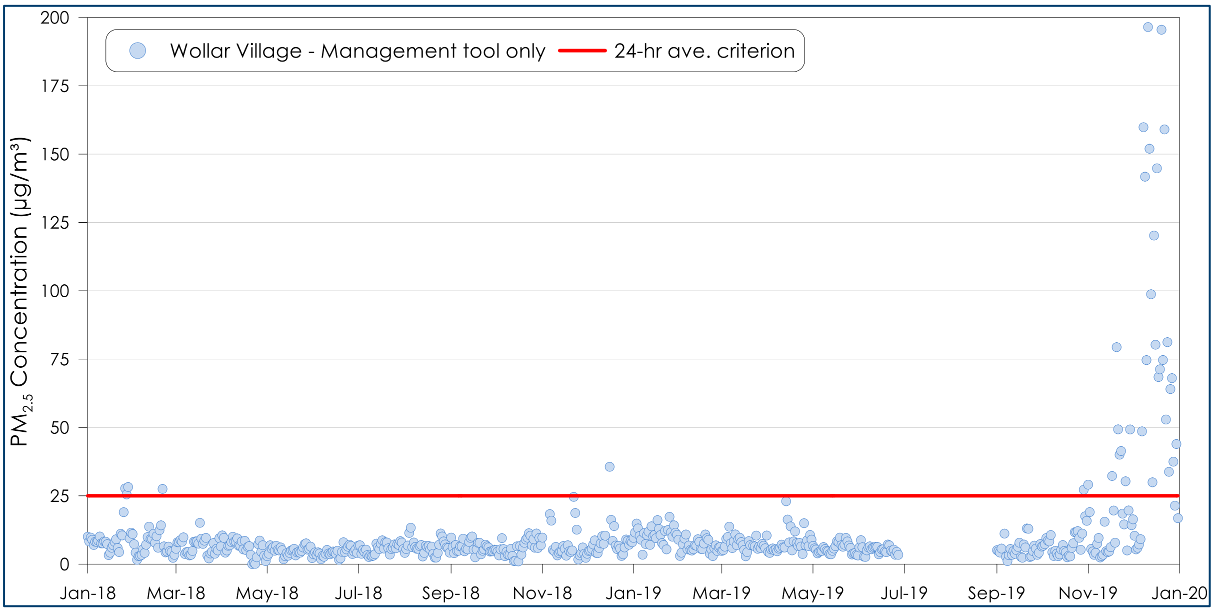


**Figure 5-1: 24-hour average $PM_{2.5}$ concentrations at TEOM monitors**

## 5.2 $PM_{10}$ monitoring

A summary of the available $PM_{10}$ monitoring data for the TEOMs and HVAS monitors is presented in **Table 5-2**. It is noted that the TEOM 3 data from 28/06/2019 to 31/08/2019 was deemed invalid due a monitor flow leak. TEOM 1 was removed from Slate Gully midway through the year.

A review of **Table 5-2** indicates that the annual average $PM_{10}$ concentrations (all days) in 2019 were above the relevant NSW EPA criteria of 25µg/m$^3$ at all $PM_{10}$ monitors and above the relevant Consent criterion of 30µg/m$^3$ at TEOM 4, HV4 and HV5. Annual average $PM_{10}$ concentrations excluding extraordinary events were below both the relevant criteria of 25µg/m$^3$ and 30µg/m$^3$ in 2019 at the relevant compliance monitors.

The 24-hour average $PM_{10}$ concentrations were above the relevant criterion of 50µg/m$^3$ for a significant number of days in 2019. The majority of these days were considered to be extraordinary events due (e.g. bushfires, dust storms, etc) which are excluded from the air quality criteria in **Table 3-1**. An analysis of each of the elevated recordings not attributable to an extraordinary event is presented in the following section.

**Table 5-2: Summary of ambient $PM_{10}$ levels**

| Year | Annual average $PM_{10}$ (µg/m³) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TEOM 1# | | TEOM 2# | | TEOM 3 | | TEOM 4 | | HV1 | | HV4 | | HV5 | | Criterion |
| 2015 | - | | 14.1 | | 11.7 | | 9.4 | | 9.8 | | 11.5 | | 11.8 | | 25 / 30 |
| 2016 | - | | 15.0 | | 10.2 | | 11.3 | | 9.8 | | 11.7 | | 13.9 | | 25 / 30 |
| 2017 | - | | 18.4 | | 9.5 | | 12.8 | | 12.3 | | 16.7 | | 16.7 | | 25 / 30 |
| 2018 | 22.1 | | - | | 14.4 | | 18.0 | | 19.7 | | 24.1 | | 25.0 | | 25 / 30 |
| 2019 | ^23.4 | *21.7 | - | - | **27.9** | *14.6 | **32.9** | *22.9 | **29.8** | *16.1 | **33.4** | *17.8 | **37.1** | *23.8 | 25 / 30 |
| **Year** | **Maximum 24-hour average $PM_{10}$ (µg/m³) (No. of days > criterion)** | | | | | | | | | | | | | | | |
| | **TEOM 1#** | | **TEOM 2#** | | **TEOM 3** | | **TEOM 4** | | **HV1** | | **HV4** | | **HV5** | | **Criterion** |
| 2015 | - | | **87.8 (3)** | | **78.5 (1)** | | **77.3 (1)** | | 29.3 | | 40 | | 35.3 | | 50 |
| 2016 | - | | 41.7 | | 34.4 | | **51.1 (1)** | | 23 | | 25.2 | | 34.2 | | 50 |
| 2017 | - | | **86.7 (11)** | | **52.2** | | **50.9 (1)** | | 28.2 | | **69.1 (1)** | | **55.4 (1)** | | 50 |
| 2018 | **206.6 (19)** | | - | | **143.3 (5)** | | **156.8 (11)** | | **168 (3)** | | **208 (2)** | | **167 (5)** | | 50 |
| 2019 | **107.8 (17)** | ***94 (9)** | - | - | **242.8 (38)** | *40.1 (0) | **273.1 (64)** | ***101.7 (12)** | **196.0 (8)** | *40.3 (0) | **207.0 (8)** | *38.0 (0) | **195.0 (12)** | ***61.0 (4)** | 50 |

# TEOM 1 and TEOM 2 are for management purposes (non-compliance)

^Insufficient data for annual average calculation, TEOM 1 removed from Slate Gully after 22 August 2019

* Excluding extraordinary events

Recorded 24-hour average $PM_{10}$ concentrations for the TEOM and HVAS monitors are presented in **Figure 5-2** and **Figure 5-3** respectively.

**Figure 5-2** and **Figure 5-3** follow similar trends and show that generally there were a significant number of elevated $PM_{10}$ levels at the end of 2019. The levels were affected by bushfire smoke across NSW during the 2019/2020 bushfire season.

The rolling annual average $PM_{10}$ concentrations for the TEOM and HVAS monitors in from 2016 to 2019 are presented in **Figure 5-4**.

The rolling annual average levels in **Figure 5-4** generally show a trend of increasing levels, with the monitors all showing a sudden increase in levels at the end of 2019 associated with the 2019/2020 NSW bushfires. The general trend of increasing dust levels over the period is considered to be predominantly due to worsening drought conditions.

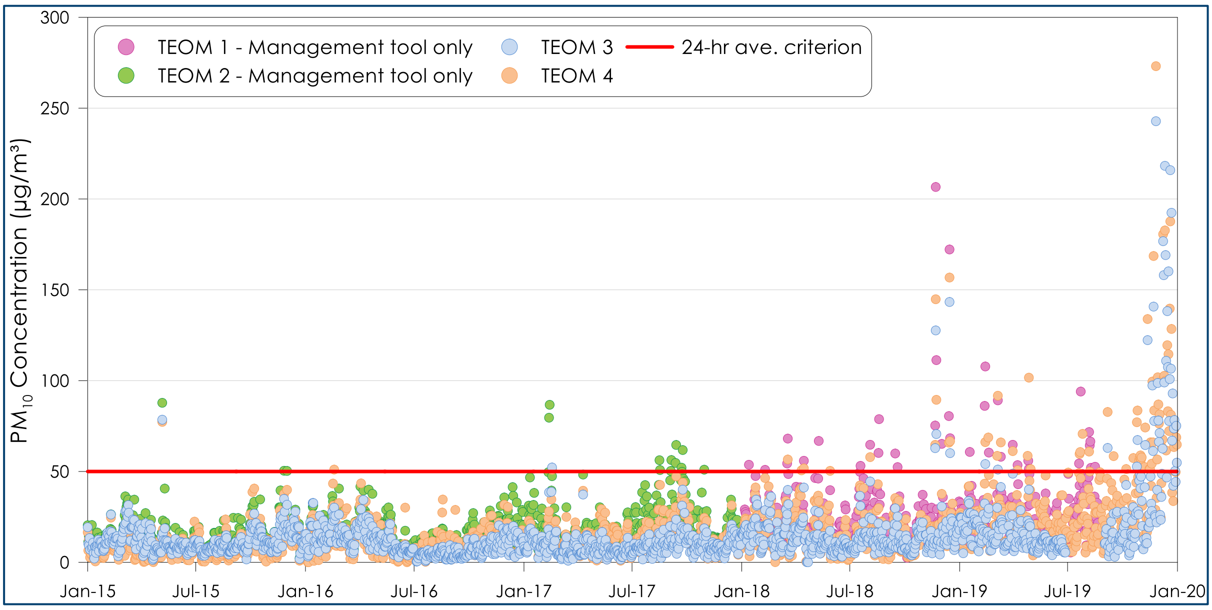


**Figure 5-2: 24-hour average $PM_{10}$ concentrations at TEOM monitors 2015 to 2019**

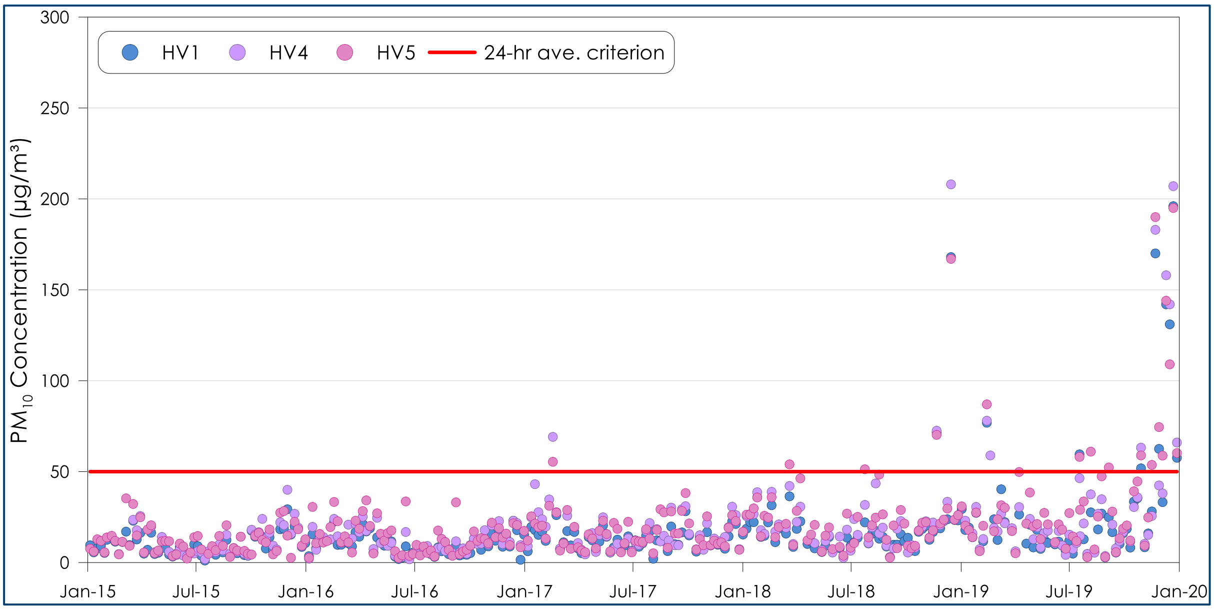


**Figure 5-3: 24-hour average $PM_{10}$ concentrations at HVAS monitors 2015 to 2019**

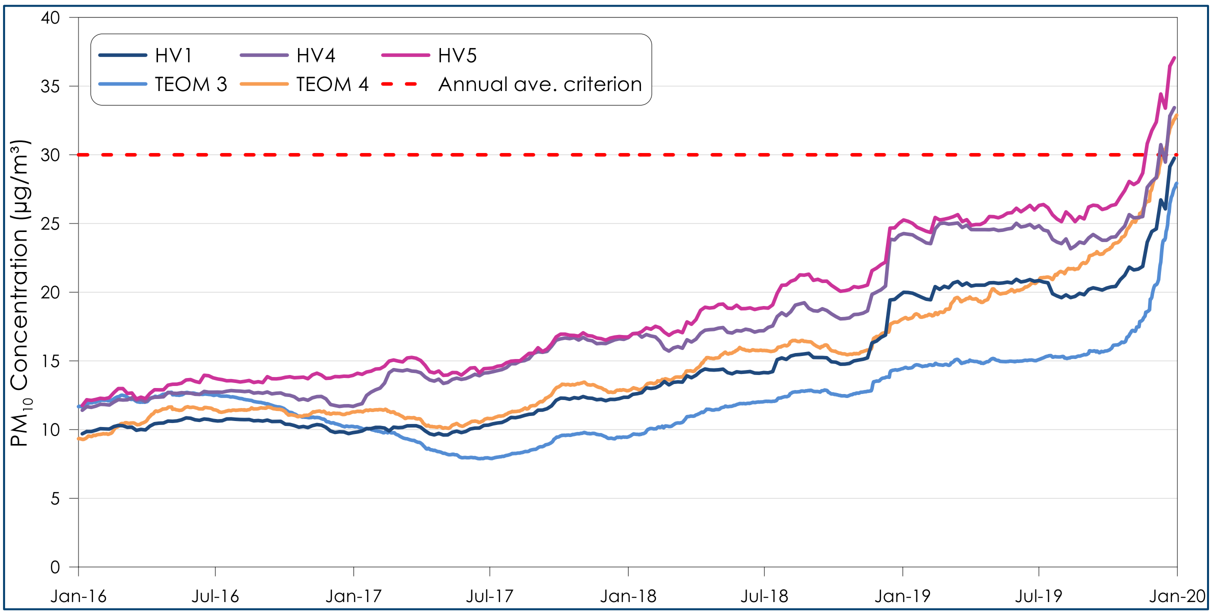


**Figure 5-4: Rolling annual average $PM_{10}$ concentrations at TEOM and HVAS monitors**

### 5.2.1 Analysis of elevated $PM_{10}$ levels

WCM has conducted investigations to determine the likely cause of elevated readings in 2019 until 26/10/2019. Elevated levels after this date have been predominately attributed to smoke associated with the 2019/2020 NSW bushfires. The likely cause of each of the elevated $PM_{10}$ recordings at the WCM monitors during 2019 is summarised in **Table 5-3**. The majority of the elevated levels in 2019 were caused by bushfire smoke, however TEOM 4 also appears to have been occasionally impacted by localised dust generated from traffic along the unsealed Araluen Road under temperature inversion conditions.

**Table 5-3: Summary of elevated 24-hour average $PM_{10}$ levels at WCM**

| Date | Monitor(s) affected | Likely cause of elevated reading | Extraordinary event (Y/N) |
|---|---|---|---|
| 13/02/2019 | TEOM 3, TEOM 4, HV1, HV4 & HV5 | Regional dust event | Y |
| 19/02/2019 | TEOM 4 & HV4 | Regional dust event | Y |
| 5/03/2019 | TEOM 4 | Regional dust event and temperature inversion trapping dust generated by traffic on the unsealed Araluen Road | Y |
| 6/03/2019 | TEOM 3 & TEOM 4 | Regional dust event | Y |
| 11/03/2019 | TEOM 4 | Regional dust event and temperature inversion trapping dust generated by traffic on the unsealed Araluen Road | Y |
| 31/03/2019 | TEOM 4 | Regional dust event | Y |
| 8/04/2019 | TEOM 4 | Temperature inversion trapping dust generated by traffic on the unsealed Araluen Road | N |
| 25/04/2019 | TEOM 4 | Temperature inversion trapping dust generated by traffic on the unsealed Araluen Road | N |
| 27/04/2019 | TEOM 4 | Temperature inversion trapping dust generated by traffic on the unsealed Araluen Road | N |
| 30/04/2019 | TEOM 4 | Temperature inversion trapping dust generated by traffic on the unsealed Araluen Road | N |

| Date | Monitor(s) affected | Likely cause of elevated reading | Extraordinary event (Y/N) |
|---|---|---|---|
| 21/07/2019 | TEOM 4 | Temperature inversion trapping dust generated by traffic on the unsealed Araluen Road | N |
| 22/07/2019 | TEOM 4 | Temperature inversion trapping dust generated by traffic on the unsealed Araluen Road | N |
| 26/07/2019 | TEOM 4 | Temperature inversion trapping dust generated by traffic on the unsealed Araluen Road | N |
| 6/08/2019 | TEOM 4 & HV5 | Temperature inversion trapping dust generated by traffic on the unsealed Araluen Road | N |
| 5/09/2019 | HV5 | Hazard reduction burn | N |
| 6/09/2019 | TEOM 3 & TEOM 4 | Regional dust event | Y |
| 16/09/2019 | TEOM 4 | Temperature inversion trapping dust generated by traffic on the unsealed Araluen Road | N |
| 7/10/2019 | TEOM 4 | Regional dust event and temperature inversion trapping dust generated by traffic on the unsealed Araluen Road | Y |
| 19/10/2019 | TEOM 4 | Regional dust event | Y |
| 25/10/2019 | TEOM 3 & TEOM 4 | Regional dust event | Y |
| 26/10/2019 | TEOM 3 & TEOM 4 | Regional dust event | Y |
| 29/10/2019 | TEOM 4, HV1, HV4 & HV5 | Bushfire smoke | Y |
| 30/10/2019 | TEOM 4 | Bushfire smoke | Y |
| 31/10/2019 | TEOM 4 | Bushfire smoke | Y |
| 1/11/2019 | TEOM 4 | Bushfire smoke | Y |
| 2/11/2019 | TEOM 4 | Bushfire smoke | Y |
| 7/11/2019 | TEOM 4 | Regional dust event | Y |
| 8/11/2019 | TEOM 3 & TEOM 4 | Regional dust event | Y |
| 12/11/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 15/11/2019 | TEOM 4 | Dust haze and regional bushfire smoke | N |
| 16/11/2019 | TEOM 4 & HV5 | Dust haze and regional bushfire smoke | N |
| 17/11/2019 | TEOM 4 | Bushfire smoke | Y |
| 19/11/2019 | TEOM 4 | Bushfire smoke | Y |
| 20/11/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 21/11/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 22/11/2019 | TEOM 3, TEOM 4 HV1, HV4 & HV5 | Bushfire smoke | Y |
| 23/11/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 26/11/2019 | TEOM 3 & TEOM 4 | Regional dust event | Y |
| 28/11/2019 | TEOM 4, HV1 & HV5 | Bushfire smoke | Y |
| 29/11/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 30/11/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 1/12/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 2/12/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 4/12/2019 | HV5 | Dust haze and regional bushfire smoke | N |
| 6/12/2019 | TEOM 4 | Bushfire smoke | Y |
| 7/12/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 8/12/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 9/12/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 10/12/2019 | TEOM 3, TEOM 4, HV1, HV4 & HV5 | Bushfire smoke | Y |
| 11/12/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 12/12/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 13/12/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |

| Date | Monitor(s) affected | Likely cause of elevated reading | Extraordinary event (Y/N) |
|---|---|---|---|
| 15/12/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 16/12/2019 | TEOM 3, TEOM 4, HV1, HV4 & HV5 | Bushfire smoke | Y |
| 17/12/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 18/12/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 19/12/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 20/12/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 21/12/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 22/12/2019 | TEOM 3, TEOM 4, HV1, HV4 & HV5 | Bushfire smoke | Y |
| 23/12/2019 | TEOM 3 | Bushfire smoke | Y |
| 24/12/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 26/12/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 27/12/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 28/12/2019 | TEOM 3, TEOM 4, HV1, HV4 & HV5 | Bushfire smoke | Y |
| 30/12/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |
| 31/12/2019 | TEOM 3 & TEOM 4 | Bushfire smoke | Y |

## 5.3 TSP monitoring

HV3 is located in Pit 8 of the approved WEP mining area. Data from HV3 is recorded for management purposes only and is not a compliance-based monitor, as described in the AQMP.

**Table 5-4** presents the annual average TSP levels. The annual average TSP concentration is below the criterion of 90µg/m$^3$ for all HVAS run days and excluding extraordinary event days in 2019.

The recorded 24-hour average TSP concentrations are presented in **Figure 5-5**. The data show an increase in the 24-hour TSP levels at the end of 2019. The levels were affected by bushfire smoke across NSW during the 2019/2020 bushfire season.

**Table 5-4: Summary of ambient TSP levels**

| Year | Annual average TSP (µg/m³) | |
|---|---|---|
| | HVAS 3# | |
| 2015 | 22.3 | |
| 2016 | 27.6 | |
| 2017 | 38.1 | |
| 2018 | 45.7 | |
| 2019 | 73.7^ | *45.8 |

# HVAS 3 is for management purposes (non-compliance)

^Insufficient data for annual average calculation (<75%), average of available data presented

* Excluding extraordinary events

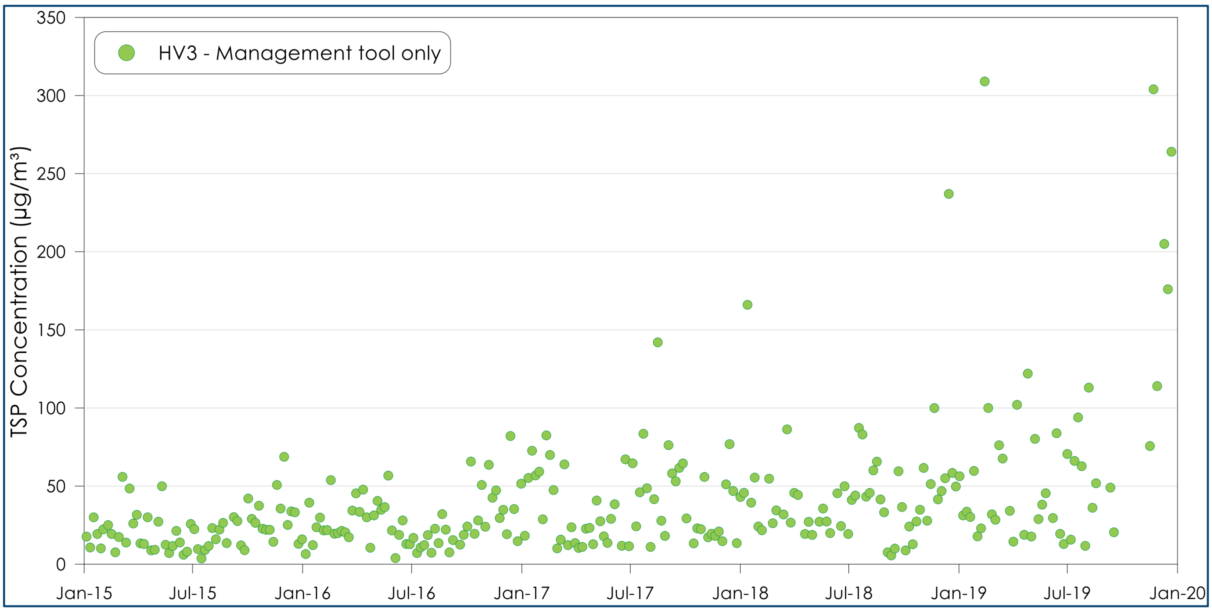


**Figure 5-5: 24-hour average TSP concentrations at HVAS monitors**

## 5.4 Deposited dust

**Table 5-5** presents the annual average deposited dust levels for all of the WCM deposited dust gauges during 2019. Monitors DG4, DG5, DG8 and DG11 are compliance monitors for assessment against the Air Quality Assessment Criteria in accordance with Condition 17, Schedule 3 of SSD-6764.

DG12, DG13, DG14 and DG16 are used for monitoring levels at heritage sites located near mining activities. Dust monitoring of heritage sites occurs when within 1km of mining activities. DG10 and DG15 are for management purposes. The data from these monitors are not representative of dust levels near receptors and are only used for diagnostic operational purposes and not compliance evaluation.

The results in **Table 5-5** indicate that deposited dust levels are below the relevant criterion of 4g/m²/month at relevant compliance monitors except for DG4 in 2019.

The monthly deposited dust levels for the compliance monitors are presented graphically in **Figure 5-6**. DG4 recorded a level of 41.9 g/m²/month in November. This high level is unlikely to be related to mining activity as it is inconsistent with the deposited dust records and may be contaminated or impacted by a localised source such as the livestock in the adjacent paddock during November. The inclusion of the November measurement greatly influences the annual average calculation. The DG4 annual average level would reduce to 1.9 g/m²/month with the exclusion of the November record.

**Table 5-5: Summary of deposited dust annual average levels for 2019 (g/m²/month)**

| Year | DG4 | DG5 | DG8 | DG10 | DG11 | DG12 | DG13 | DG14 | DG15 | DG16 |
|---|---|---|---|---|---|---|---|---|---|---|
| 2015 | 1.1 | 0.9 | 1.2 | **4.4** | 2.3 | 3.6 | **7.5** | 1.4 | 0.9 | - |
| 2016 | 0.7 | 1.3 | 1.1 | 1.9 | **4.6** | 2.5 | **33.8** | **4.8** | 1.6 | - |
| 2017 | 1.3 | 1.4 | 1.9 | **4.3** | 1.8 | 3.7 | **10.5** | **26.3** | 1.2 | - |
| 2018 | 3.2 | 2.0 | 1.7 | 3.7 | 2.2 | **5.2** | **4.1** | **6.6** | 1.3 | **8.9** |
| 2019 | **5.3** | 2.7 | 2.3 | **4.6** | 3.1 | **5.9** | 3.3 | **5.5** | 1.6 | **7.0** |

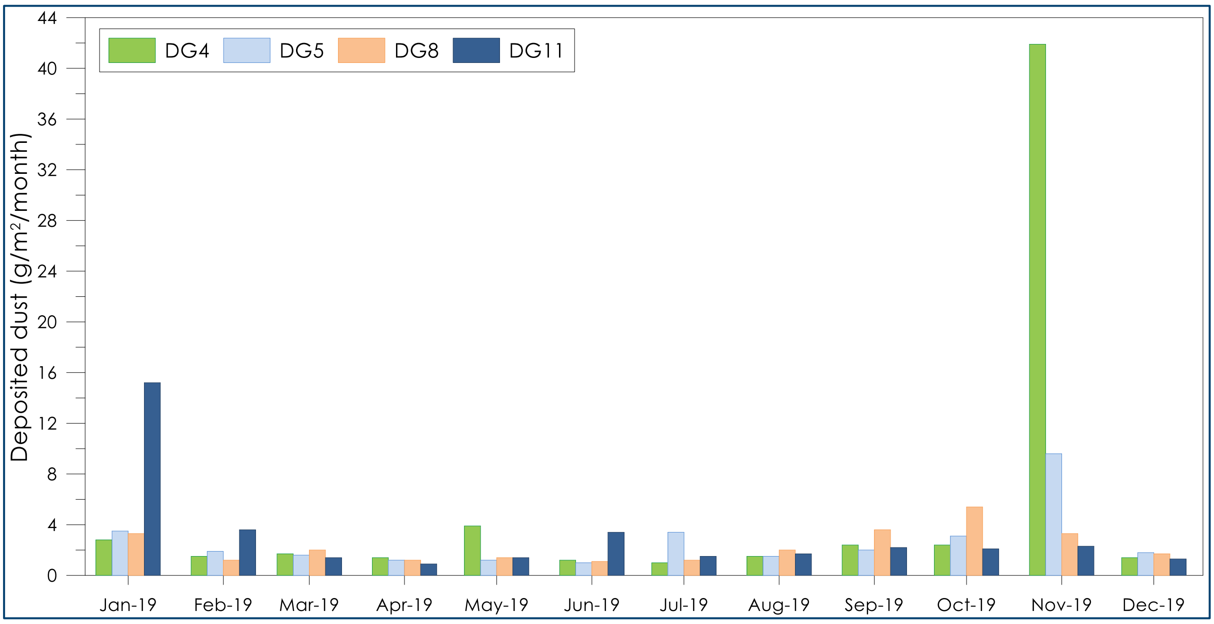


**Figure 5-6: Monthly average deposited dust levels**

# 6 COMPARISON BETWEEN MEASURED DATA AND MODELLED RESULTS

Monitoring data collected as part of the WCM ambient air quality monitoring network during 2019 was compared with modelling predictions for the Year 2020 per the *Air Quality and Greenhouse Gas Assessment Wilpinjong Extension Project* (**Todoroski Air Sciences, 2015**).

## 6.1 Annual average $PM_{10}$

**Figure 6-1** presents the measured 2019 annual average $PM_{10}$ data excluding extraordinary events superimposed over the dispersion modelling contours for the Year 2020. The measured and predicted data in the figure include dust levels from WCM and other sources.

**Figure 6-1** shows there is generally a good correlation between the modelling results and the recorded levels at the air quality monitors excluding the extraordinary events in 2019.

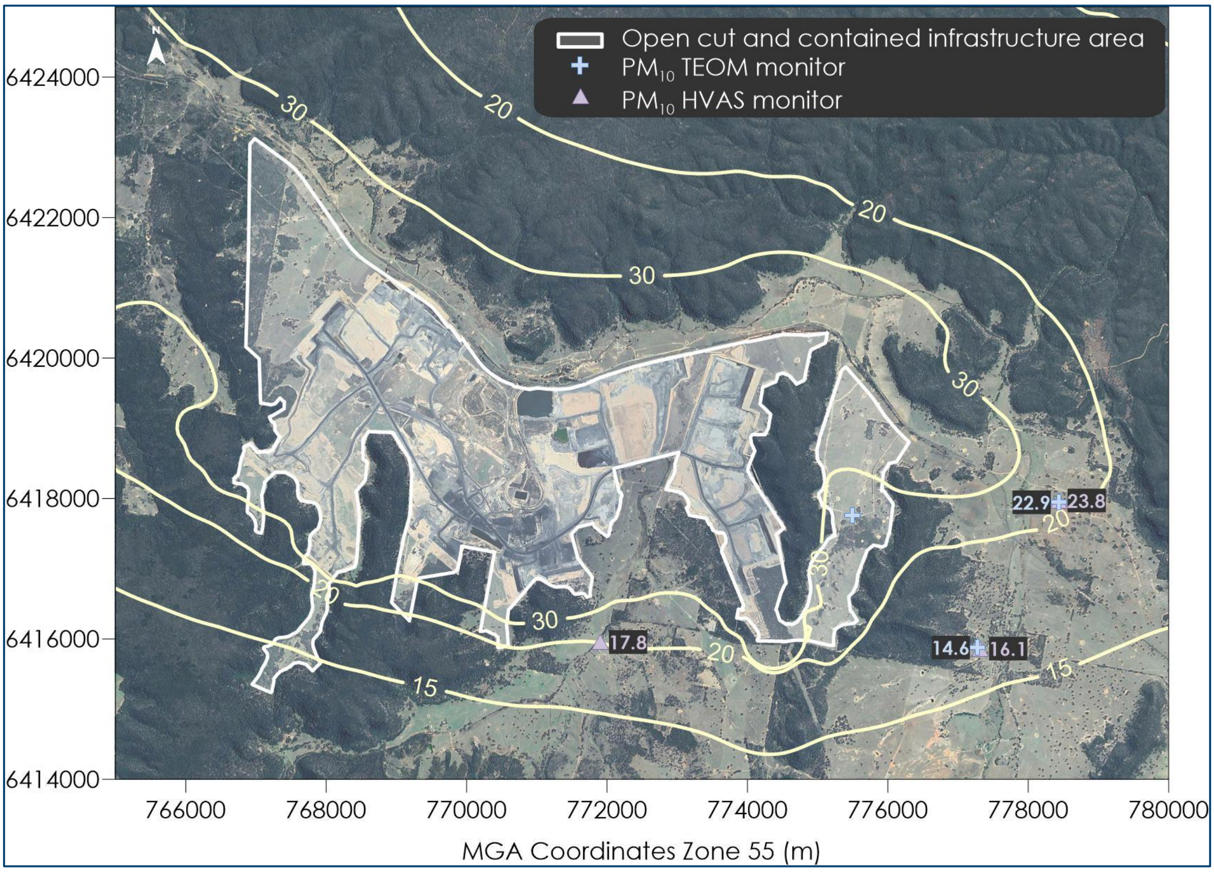


**Figure 6-1: Annual average $PM_{10}$ monitoring data for 2019 superimposed over the predicted $PM_{10}$ annual average modelling contour (Year 2020 WCM plus other mines and background)**

## 6.2 24-hour average $PM_{10}$

**Figure 6-2** presents an overlay of the maximum measured 24-hour average $PM_{10}$ data in 2019 excluding extraordinary events, over the incremental dispersion modelling predictions for WCM alone for Year 2020. The contours do not include the background dust levels and dust from other sources whereas the measured levels do.

Generally the measured 2019 24-hour average $PM_{10}$ levels are higher than the predicted incremental impacts. It needs to be noted that short term, 24-hour average dust levels are heavily influenced by background dust levels which can vary greatly day to day and year to year (say in a drought year), for example the 24-hour average dust level at TEOM 4 was impacted on occasion by dust from traffic along the unsealed road trapped under temperature inversion conditions (as identified in **Table 5-3**).

An important factor is also the exact location of mining activity on a given day. The modelling has activity fixed in one place for a full year, and uses a year of historical weather data, this it cannot exactly predict 24-hour levels on every day, but does provide a good indication.

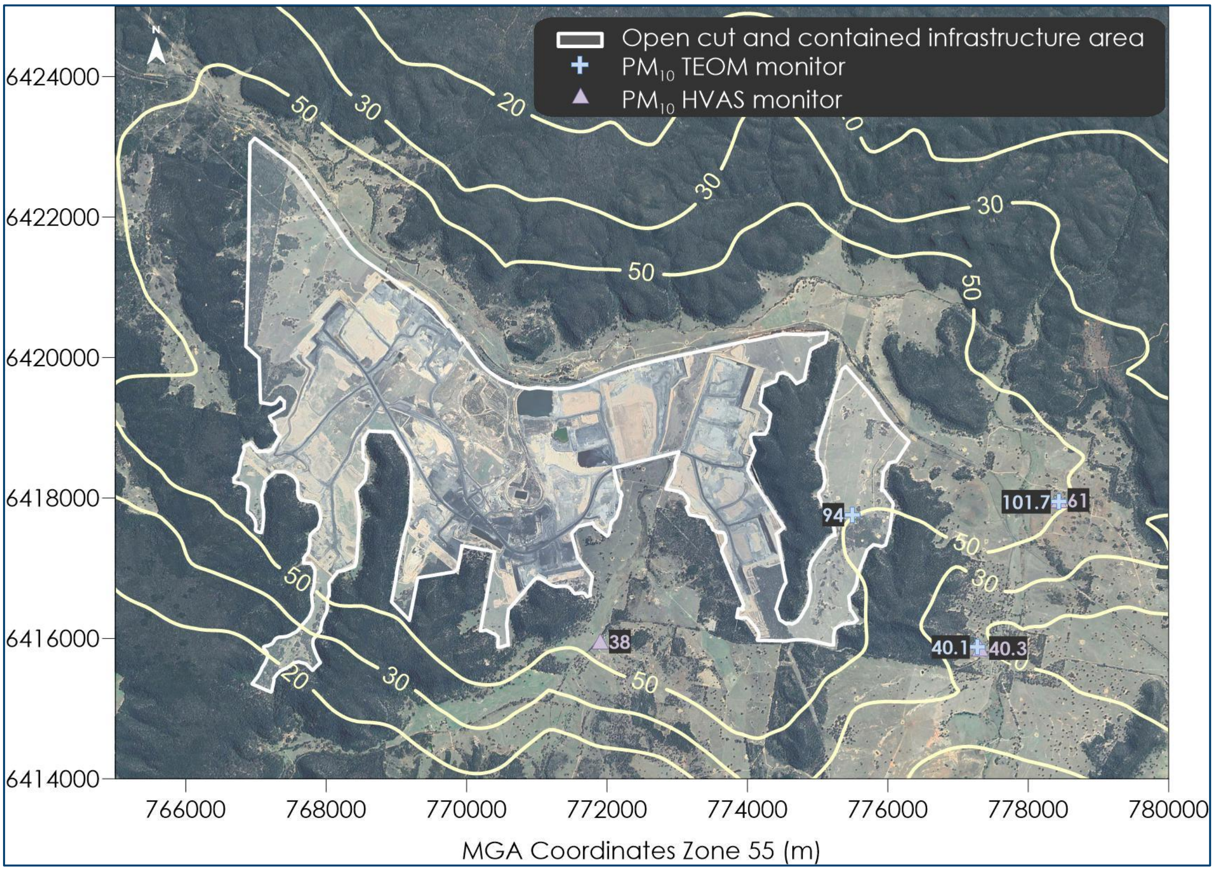


**Figure 6-2: 24-hour average $PM_{10}$ monitoring data for 2019 superimposed over the predicted $PM_{10}$ 24-hour average modelling contour (Year 2020 WCM incremental impact)**

## 6.3 Annual average $PM_{2.5}$

**Figure 6-3** presents an overlay of the measured 2019 annual average $PM_{2.5}$ data over the dispersion modelling predictions for Year 2020. The measured result is below the criteria and is typical of a small village, or levels in the clean parts of urban areas in NSW.

The measured levels are higher than the modelled results by approximately 3 to 4µg/m³. The $PM_{2.5}$ monitor is located in the village of Wollar and will be influenced by non-modelled local $PM_{2.5}$ sources such as combustion engines, transport movements and various human activities.

The modelling does not account for excess dust from the human activities in the village. The difference between the measured and modelled results is consistent with the difference in $PM_{2.5}$ levels measured in small populated areas and those outside of the populated areas and near mines in the Hunter Valley.

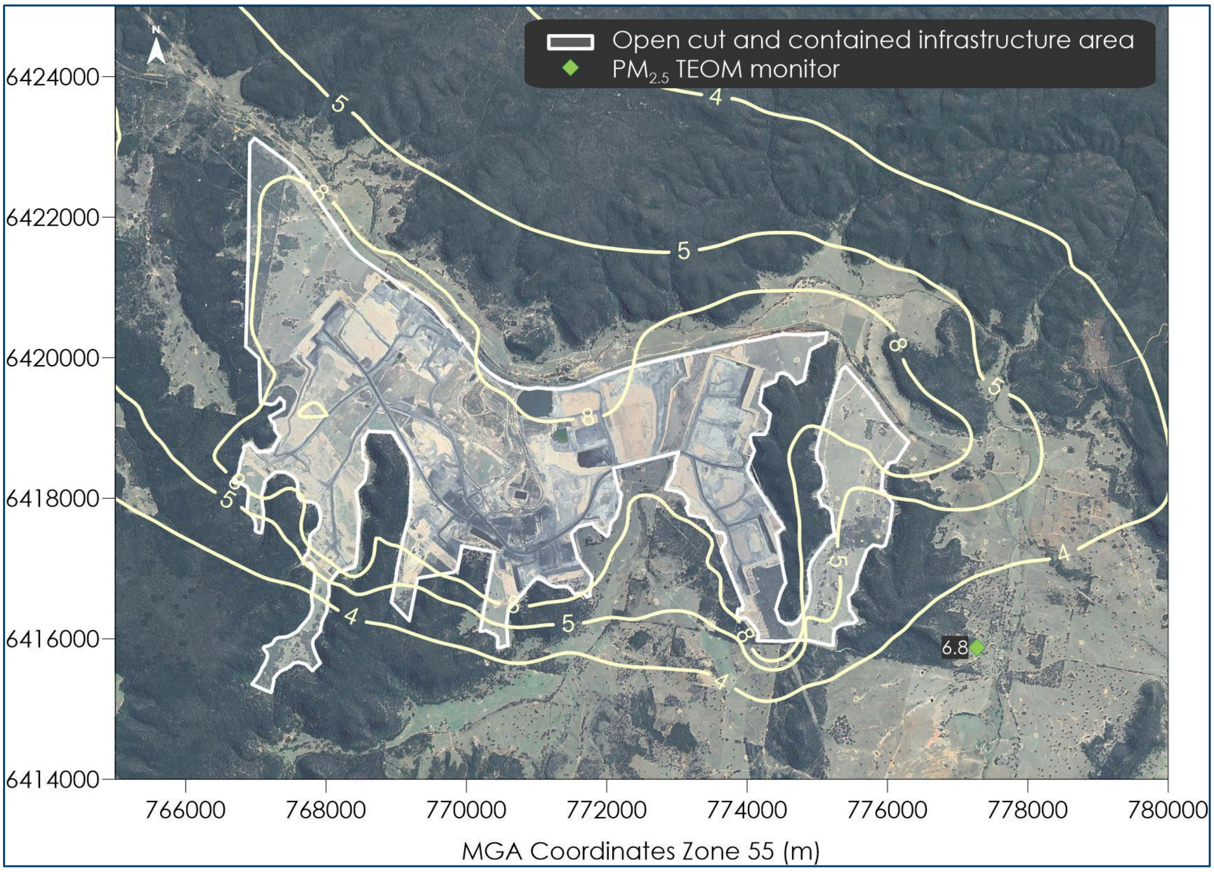


**Figure 6-3: Annual average $PM_{2.5}$ monitoring data for 2019 superimposed over the predicted $PM_{2.5}$ annual average modelling contour (Year 2020 WCM plus other mines and background)**

## 6.4 Annual average TSP

**Figure 6-4** presents an overlay of the measured 2019 annual average TSP data excluding extraordinary days over the dispersion modelling predictions. Note that there are insufficient data for an annual average calculation (i.e. less than 75%) at the TSP HVAS monitor, however an average of the available data has been presented for the purpose of this comparison.

The average TSP level excluding extraordinary events in 2019 is in reasonably close agreement with the modelled result for the Year 2020 modelling year.

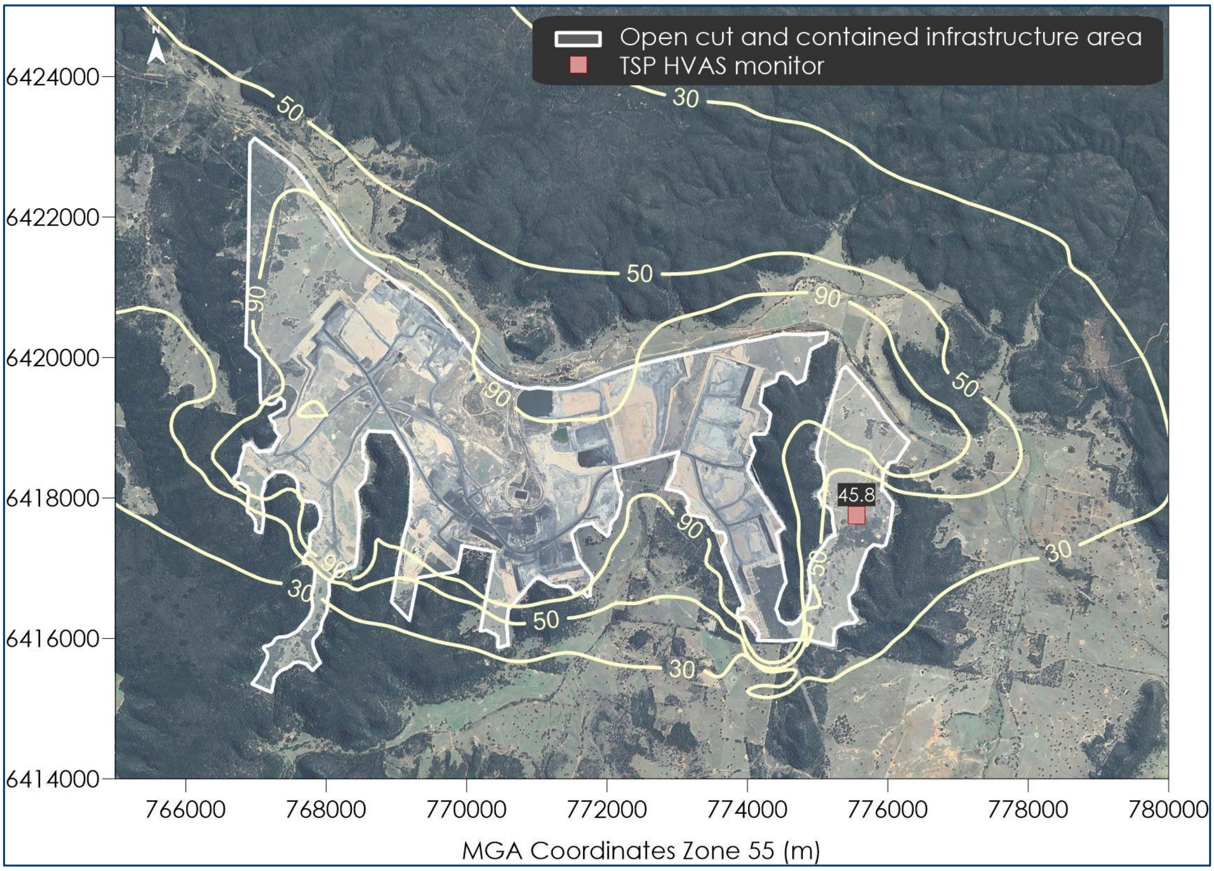


**Figure 6-4: Annual average TSP monitoring data for 2019 superimposed over the predicted TSP annual average modelling contour (Year 2020 WCM plus other mines and background)**

## 6.5 Annual average deposited dust

**Figure 6-5** presents an overlay of the measured 2019 annual average deposited dust levels over the dispersion modelling contours for Year 2020.

The annual average measured levels in 2019 are generally higher than the model predictions for most of the deposited dust gauges. We note that deposited dust gauge readings can be significantly influenced by very local sources and this cannot be reasonably factored in any modelling. In addition, drought conditions and extraordinary events would have impacted the background deposited dust levels in 2019.

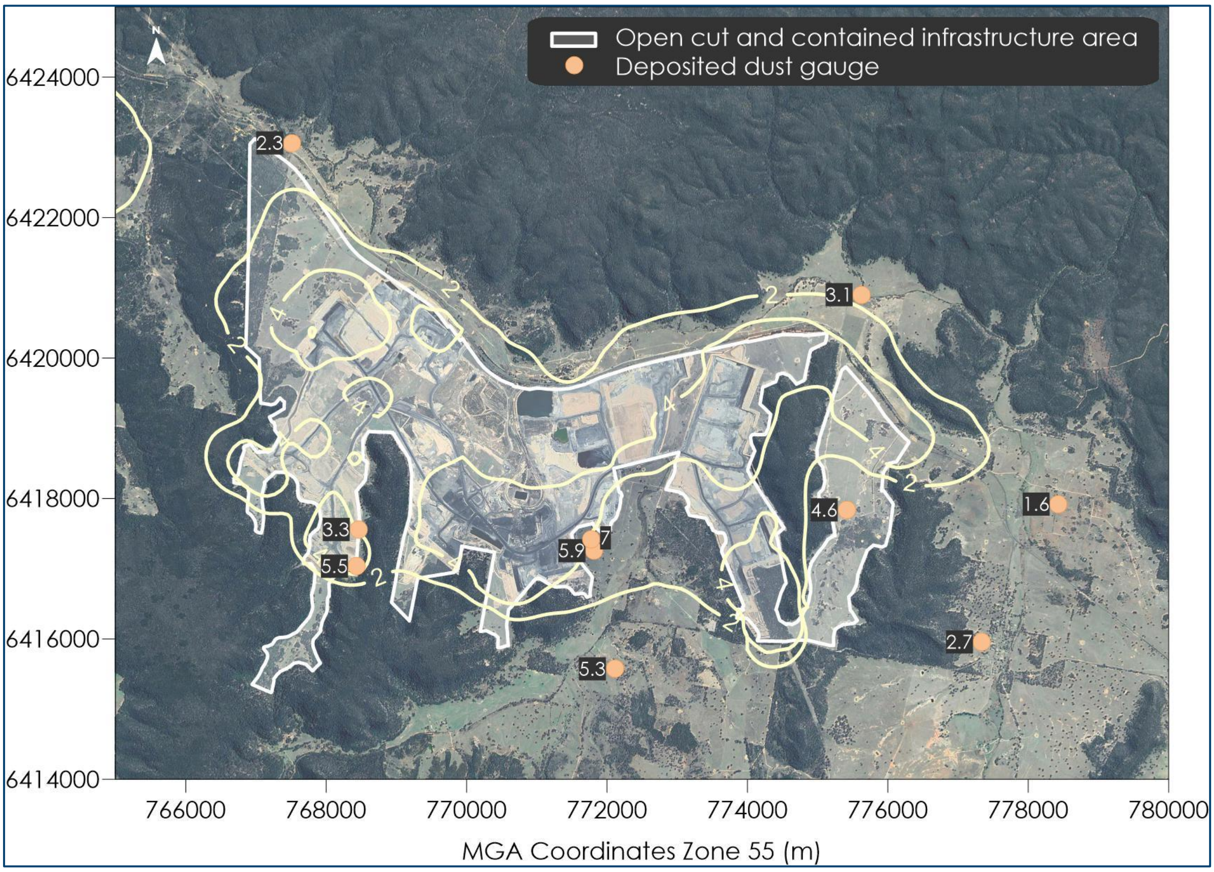


**Figure 6-5: Annual average deposited dust monitoring data for 2019 superimposed over the predicted deposited dust annual average modelling contour (Year 2020 WCM plus other mines and background)**

# 7 SUMMARY AND CONCLUSIONS

This report has analysed the monitoring data recorded at the WCM for the 2019 calendar period and provides a comparison between the measured dust levels with the modelled predictions for the Year 2020 per the *Air Quality and Greenhouse Gas Assessment Wilpinjong Extension Project* (**Todoroski Air Sciences, 2015**).

The analysis shows that there was generally good agreement between the annual average modelling predictions and the measured results excluding extraordinary event days in 2019.

This report has also presented a review of the 2019 data against the latest five years of data. The analysis shows that the annual levels were generally high compared with previous years and that there was an increase in the number of exceedances of the short term $PM_{10}$ and $PM_{2.5}$ criteria in 2019, due to the large number of extraordinary events (the 2019/2020 bushfires in particular). The annual average levels excluding extraordinary events were generally similar to the previous year results and below the relevant annual criteria.

# 8 REFERENCES

NEPC (2016)

"National Environment Protection (Ambient Air Quality) Measure", National Environment Protection Council, February 2016.

NSW Department of Primary Industries (2020)

"NSW State Seasonal Update – December 2019", NSW Department of Primary Industries, accessed March 2020, https://www.dpi.nsw.gov.au/climate-and-emergencies/seasonal-conditions/ssu/december-2019.

NSW EPA (2017)

"Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales", NSW Environment Protection Authority, January 2017.

Todoroski Air Sciences (2015)

"Air Quality and Greenhouse Gas Assessment Wilpinjong Extension Project", prepared for Wilpinjong Coal Pty Ltd by Todoroski Air Sciences, November 2015.

**Appendix A: Extraordinary event days**

The following days were considered to be extraordinary events in 2019 for Wilpinjong:

- 13/02/2019
- 19/02/2019
- 5/03/2019
- 6/03/2019
- 11/03/2019
- 31/03/2019
- 26/04/2019
- 8/08/2019
- 9/08/2019
- 6/09/2019
- 7/10/2019
- 19/10/2019
- 25/10/2019
- 26/10/2019
- 29/10/2019
- 30/10/2019
- 31/10/2019
- 1/11/2019
- 2/11/2019
- 7/11/2019
- 8/11/2019
- 12/11/2019
- 17/11/2019
- 18/11/2019
- 19/11/2019
- 20/11/2019
- 21/11/2019
- 22/11/2019
- 23/11/2019
- 26/11/2019
- 28/11/2019
- 29/11/2019
- 30/11/2019
- 1/12/2019
- 2/12/2019
- 6/12/2019
- 7/12/2019
- 8/12/2019
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